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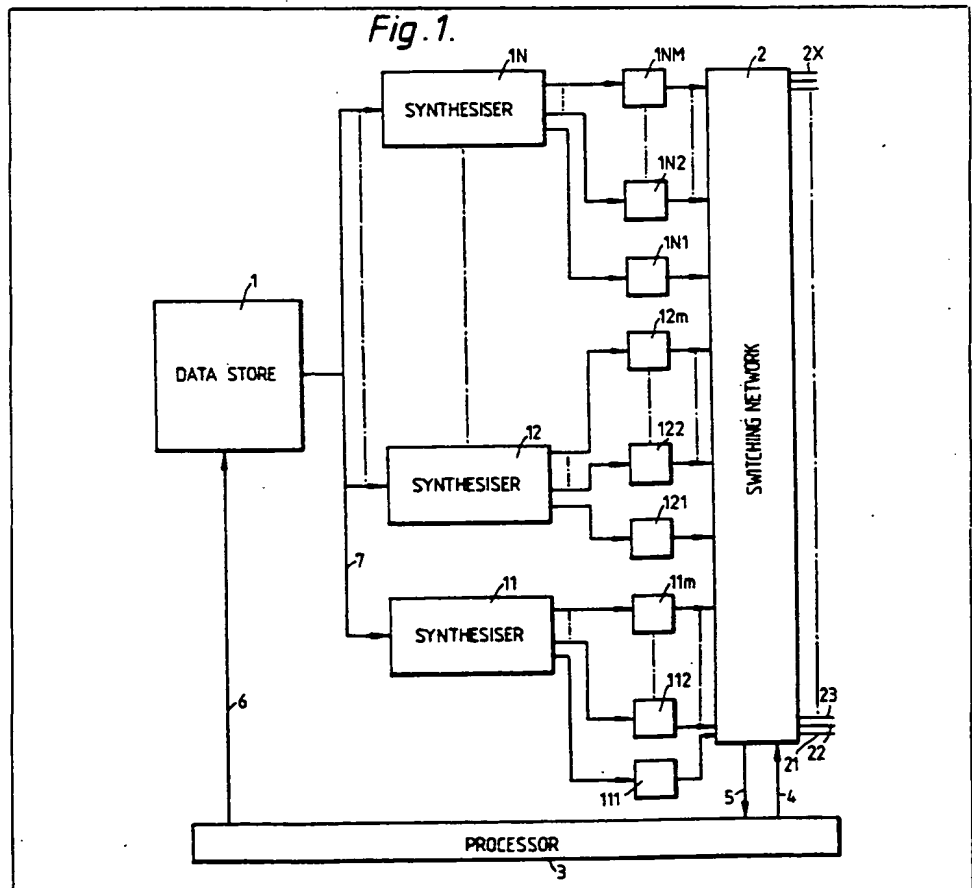
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(54) **Method of and apparatus for generating a plurality of electric signals**

(57) To provide a speech message output to a subscriber from a telephone exchange, data defining a number of words and phrases is stored in a data store (1). On determining the need for a message output a controlling processor (3) selects the data for the appropriate words and transfers the data in the correct order to a synthesiser (11-1N). The synthesiser outputs complete sentences in pulse-code-modulated form to an output channel of a digital switch. In addition to providing user information as a replacement for (e.g.) engaged tone, number unobtainable etc. the system may be used to provide speaking clock, weather forecast and like facilities. Use of the system

in user guidance is also disclosed. The data stored is linear predictive encoded.



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Fig. 1.

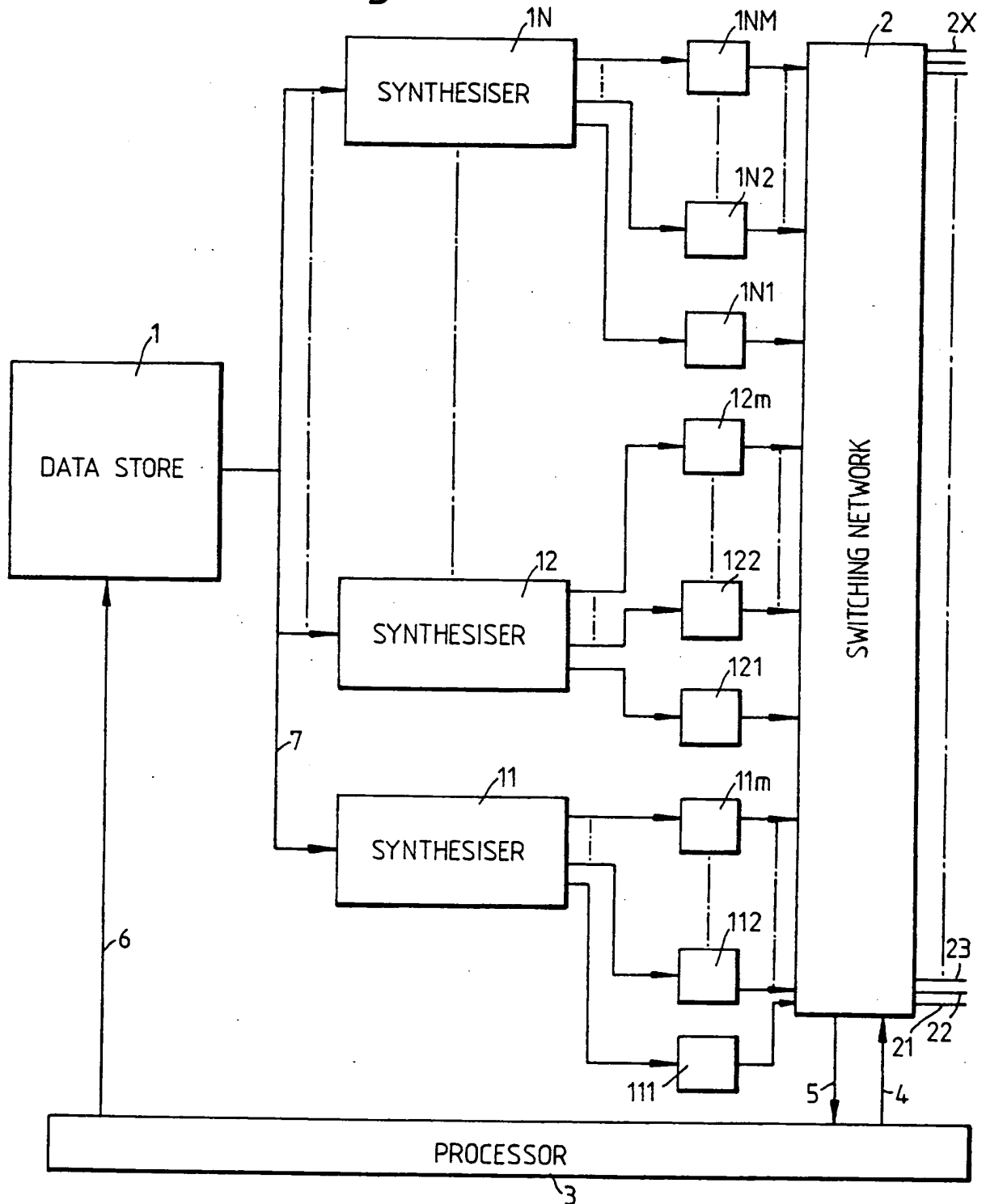


Fig. 2.

A	ZERO 1	ONE 1	TWO 1	THREE 1	FOUR 1	FIVE 1	SIX 1	SEVEN 1	EIGHT 1	NINE 1
B	ZERO 2	ONE 2	TWO 2	THREE 2	FOUR 2	FIVE 2	SIX 2	SEVEN 2	EIGHT 2	NINE 2
C	ZERO 3	ONE 3	TWO 3	THREE 3	FOUR 3	FIVE 3	SIX 3	SEVEN 3	EIGHT 3	NINE 3
D	PLEASE 1		PLEASE 2		SORRY			TRY AGAIN		
E	FOR THE DELAY			YOU HAVE DIALLED			THE NUMBER			
F	INCORRECTLY		IS OUT OF SERVICE		IS ENGAGED		BUT WE ARE			
G	TRYING TO CONNECT YOU			WAIT FOR DIAL TONE BEFORE DIALLING						
H	CALL 1	CALL 2	THE OPERATOR	YOUR	TIME HAS EXPIRED	THERE IS		HOURS		
J	A FAULT		NO REPLY		CANNOT BE ACCEPTED		THIS IS		ALARM	FOR
K	YOU HAVE BOOKED AN			CHECK THE		CODE	AND	TELEPHONE NUMBER		

SPECIFICATION

Method of and apparatus for generating a plurality of electric signals

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The present invention relates to generating a plurality of electric signals and in particular, but not exclusively, generating electric signals for use in telecommunications exchanges.

- 10 Generally speaking, telephone administrations use tone signals to indicate to a caller, the progress of a telephone call. Such tone signals inform the caller whether the call has failed for some reason ("Number Unobtainable"), whether the called telephone is busy ("Engaged tone") or whether equipment is busy ("congestion tone").

- 15 If the call is successful, as far as the exchange equipment is concerned, the caller will receive "ringing tone" indicating that ringing current is being applied to the called telephone.

- Tones are used in preference to speech information because it is usually easier to produce a multiplicity of tones which may be distributed around a telephone exchange for access by all equipment which may detect the need to return a tone to the caller.

- 20 It will be appreciated that if multiple access speech information could be produced at a reasonable cost the caller could be much better informed as to the progress of or reason for failure of his telephone call.

- It is an object of the present invention to provide a method of and apparatus for generating a plurality of electric signals suitable for use in providing a multiple access speech output system.

- 30 According to one aspect of the present invention a method of generating a plurality of electric signals for use in providing a spoken message comprises the steps of storing data defining a plurality of words and/or phrases in a data store, selecting from the stored data a plurality of the words and/or the phrases in dependence on electric signals determining a required message, and processing the selected data to provide electric signals with the correct sequence and timing to define the message for transmission to line.

- 40 According to a second aspect of the present invention in a signal generator for generating a plurality of electric signals for use in providing a spoken message, data defining a plurality of words and/or phrases is stored in a data store, control means responsive to signals on an input path thereof is arranged to select from the data defining the plurality of words and/or phrases message data defining a message comprising a plurality of the words and/or phrases, and a synthesiser is arranged to convert the data into electric signals having the correct sequence and timing to define the message in a form suitable for transmission to line.

- Preferably a plurality of synthesisers each having a plurality of selectable outputs are arranged to convert respective data into electric signals and the control means is arranged to select respective message data for each of the outputs.

- The selectable outputs may be time division multiplexed (T.D.M.) channels and the electric signals at the outputs may define the message in a pulse code modulated (P.C.M.) format. The data held in the data store may be parametrised speech data derived by voice model speech encoding.

- Data defining particular phrases and/or words in several forms may be held in the data store to provide electric signals which, when converted to an audio signal, provide forms of the phrases and/or words having differing intonations. The control means may be arranged to select data defining a particular phrase and/or word in dependence on the position of the phrase and/or word in the message.

- In particular data defining the digits zero to nine is stored in three forms and the form to be used is selected in accordance with the location of the digit within a string of digits. The three forms of digits are respectively for use when a digit is at the start, in the middle and at the end of a string of digits.

- Signal generating apparatus in accordance with the invention will now be described by way of example with reference to the accompanying drawings of which

- 100 *Figure 1* is a block schematic diagram of a part of a telephone exchange including the signal generating apparatus,

- Figure 2* shows a table of phrases and words data for which are held in the data store of *Fig. 1*.

- Referring to *Fig. 1* the signal generating apparatus comprises a data store 1 arranged to store data defining an audio (speech) output, and a number of synthesisers 11 to 1N arranged to convert the data held in the data store into pulse-code-modulated (PCM) signals for subsequent conversion to speech signals.

- Each of the synthesisers 11 to 1N has a number of output ports or channels 111 to 11M, 121 to 12M and 1N1 to 1NM each of which is connected to an input port or channel of a digital switching network 2 to provide PCM signals by way of the switching network 2 to a number of outlet ports or channels 21 to 2X. The outlet channels 21 to 2X may be connected to subscribers lines or to junction or trunk lines to other telephone exchanges.

- The digital switching network 2 is controlled by a processor 3 which is arranged to set up connections between the channels 21 to 2X. A data bus is provided for forwarding control signals to the switching network 2.

- If the processor 3 detects a fault in the switching network 2 which prevents the connection of a call originating on one of the

channels 21 to 2X (say, 21) it is arranged to set up a connection between an output channel (say 111) of the synthesiser 11 and the channel 21.

5 The processor 3 then causes data from the data store 1 to be transferred to an input buffer (not shown) of the synthesiser 11 together with an addressing signal indicating that the data is to be used to send a message by way of output channel 111. For this purpose the processor 3 forwards to the data store 1 by way of a data bus 6 data defining the address of the synthesiser 11, the output channel 111 and the addresses of the data to be transferred. This data causes the data store 1 to forward data by way of a data bus 7 to enable the synthesiser 11, to determine output channel 111 and to determine the output message to be sent.

20 Turning now to the kind of data stored in the data store 1 our co-pending Patent Application No. 8123499 discloses apparatus for parametrisation of analogue speech waveforms using a method known as linear predictive coding. Data derived by use of this method is stored in the data store 1 and defines a number of phrases and words which are shown in Fig. 2.

Referring also to Fig. 2 the words and phrases stored in the store 1 of a typical telephone exchange are shown. No attempt has been made to show the words and phrases in a manner which indicates the amount of data storage required for each word or phrase.

35 However, if the words shown in lines A to K are read through at an average announcement speed it will take approximately one minute. Using the method described in our co-pending patent application No. 8123499 approximately 100 seconds of speech may be stored in a 64 kilobyte (1 byte = 8 bits) read-only-memory without employing word concatenation. Approximately four kilobits of data is held in the data store 1 for each one second of speech and the synthesisers 12 to 1N use this data to generate 64 kilobit per second pulse code modulated signals for transmission by way of the digital switching network 2.

50 If in processing dialled digits of a telephone call the processor 3 determines that the called telephone is engaged it is arranged to cause the data store 1 to send to the synthesiser "The number" (from line E) "you have dialled" (also from line E) "is engaged" (from line F). Thus the caller receives a complete sentence indicating the reason for the non-completion of his call and no connection is required through the switching network to the engaged line.

60 In some circumstances, for example when there is a line fault, the processor 3 having failed to connect the call makes a "repeat attempt" to connect the call through the switching network 2 to another line or by

another route. This mode of operation can cause delay which may result in a caller releasing the connection prematurely and trying again.

70 If the processor 3 enters a repeat attempt routine it may cause the data store 1 to transfer data to the appropriate synthesiser 11 to 1N to send a message such as "sorry" (line D) "there is" (line H) "a fault" (line J) "but we are" (line F) "trying to connect you" (line G). In other circumstances where a delay is not due to a fault the processor 3 may cause the data store 1 to transfer only the message "trying to connect you".

80 Having shown the construction of some typical messages and demonstrated the data saving which may be achieved by dual use of such phrases as "trying to connect you" it is necessary to explain the apparent extravagant use of data space by storing the data for the digits zero to nine three times and certain other words more than once.

To maintain a high quality message output when for example a string of digits is to be recited the three versions of the digits stored in lines A, B and C are for use respectively at the beginning, in the middle and at the end of the string. For example in the string "12345" the intelligibility is enhanced if when spoken the "one" has a rising cadence and the "five" a falling cadence. The falling cadence of the "five" also helps to indicate the end of the string. Take for example a message (constructed from the phrases and words of the data store) "You have dialled 08652913 please check the code and telephone number". In the string 08652913 the zero (spoken as "oh") will be selected from line A, 865291 will be selected from line B and the "three" will be selected from line C.

105 Supposing that the caller has missed the final digit of the telephone number it will be apparent to him from the cadence of the "three".

110 As another example of cadence changes consider the spoken phrases "please try again" and "call the operator please". The cadence and emphasis of the "please" is different in each case and by storing two versions of the word "please" a more "human" tone may be given to the machine output.

Whilst as shown herein three versions of the digits are stored, it will be appreciated that more versions may be stored if it is believed that greater intelligibility or a more "human" tone may be required.

Although the list is not exclusive other sentences which are commonly used in telecommunications and which may be selected from the exemplary words and phrases shown in Fig. 2 are:-

"Sorry for the delay"
"You have dialled incorrectly"
130 "Please wait for dial tone before dialling"

"The number you have dialled is out of service"

"Sorry there is no reply"

"Your call cannot be accepted"

5 "Please call directory enquiries"

"You have booked an alarm call for (NNNN) hours"

"This is your alarm call"

and "Your call time has expired"

10 It will be realised that in addition to replacing "tone" signals in telecommunications exchanges the system herein described may be used to provide "voice guidance" to users of new facilities. For example a telephone user
15 dialling a "special facilities" code may be advised of the facilities available and of a further code to be dialled to select each of those facilities.

The system may also be used to provide
20 such facilities as a speaking clock without the inconvenience of a recorded tape or multiple disc system. Periodically updated information such as recorded weather forecasts or road information may also use the system.

25 CLAIMS

1. A method of generating a plurality of electric signals for use in providing a spoken message comprising the steps of storing data
30 defining a plurality of words and/or phrases in a data store, selecting from the stored data a plurality of the words and/or phrases in dependence on an electric signal determining a required message, and processing the selected data to provide an electric signal with
35 the correct sequence and timing to define the message.

2. A signal generator for generating a plurality of electric signals for use in providing a
40 spoken message wherein data defining a plurality of words and/or phrases is stored in a data store, control means responsive to signal on an input thereof is arranged to select from the stored data data defining a message comprising a plurality of the words and/or
45 phrases, and a synthesiser is arranged to convert the data into an electric signal having the correct sequence and timing to define the message.

3. A signal generator as claimed in Claim 2 in which a plurality of synthesisers are arranged to convert respective data into respective electric signals and the control means is arranged to select respective message data
55 for each of the synthesisers.

4. A signal generator as claimed in Claim 2 in which the synthesiser has a plurality of selectable outputs and the control means is arranged to select respective message data for
60 each of the outputs.

5. A signal generator as claimed in Claim 4 in which each of the selectable outputs is a time division multiplexed channel of a switching network.

65 6. A signal generator as claimed in any

one of Claims 2 to 5 in which the electric signals define the message in a pulse-code modulated format.

7. A signal generator as claimed in any
70 one of Claims 2 to 6 in which the stored data is parametised speech data derived by voice model speech encoding.

8. A signal generator as claimed in Claim 7 in which the parametised speech data is
75 derived by linear predictive coding.

9. A signal generator as claimed in any one of Claims 2 to 8 in which data defining particular ones of the plurality of words and/or phrases is stored in the data store in a
80 plurality of forms for conversion to respective electric signals which, when converted to an audio signal, provide forms of the particular words and/or phrases having differing intonations.

10. A signal generator as claimed in Claim 9 in which the control means is arranged to select data defining one of said particular phrases and/or words in dependence on the position of that phrase or word in the message.
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11. A signal generator as claimed in Claim 10 in which data defining the digits zero to nine is stored in three different forms and the form selected for use is determined in dependence on the location of the digits in a string of digits.
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12. A method of generating a plurality of signals for use in providing a spoken message substantially as hereinbefore described with reference to the accompanying drawings.
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13. A signal generator for generating a plurality of electric signals for use in providing a spoken message substantially as hereinbefore described with reference to the accompanying drawings.
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